

(8) JP, 2001-214441, A

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-294441

(43)Date of publication of application : 23.10.2001

(51)Int.Cl.

C03C 3/093
C03C 3/087
G09F 9/30
G11B 5/73

(21)Application number : 2000-109803

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(22)Date of filing : 11.04.2000

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(54) GLASS FOR SUBSTRATE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide glass for a substrate which is hardly broken and having a high weather resistance and glass transition temperature and mass-producible.

SOLUTION: This glass for the substrate consists of 59-72 mass % SiO₂, 1-15 wt.% Al₂O₃, 0.5-9 wt.% MgO, 0.5-11 wt.% CaO, 0-6 wt.% SrO, 0.5-10.5 wt.% ZrO₂ and 4-21 wt.% K₂O on the conditions that MgO+CaO+SrO+BaO is 4-49 wt.% Li₂O+Na₂O+K₂O is 10-22 wt.% and SiO₂-Al₂O₃ ≥ 50 wt.% and the specific gravity of this glass is less than 2.6.

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[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application] ~

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

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CLAIMS

[Claim(s)]

[Claim 1] By mass-percentage display, substantially SiO₂ 59 - 72%, aluminum 2O₃ 1 - 15%, B₂O₃ 0 - 3%, MgO 0.5 - 9%, CaO 0.5 - 11%, SrO 0 - 6%, BaO 0 - 5%, TiO₂ 0 - 6%, ZrO₂ 0.5 - 10.5%, Li₂O 0 - 3%, Na₂O 0 - 9%, K₂O 4 - 21% — since — the glass for substrates 50% or more and whose specific gravity the difference of the content of 10 - 22% and SiO₂ and the content of aluminum 2O₃ is [the sum total of the content of MgO, CaO, SrO, and BaO] less than 2.6 for the sum total of 4 - 19%, and the content of Li₂O, Na₂O, and K₂O.

[Claim 2] Glass for substrates according to claim 1 whose brittleness index value B is 1/2 or less [7400m -].

[Claim 3] Glass for substrates according to claim 1 or 2 whose glass transition point is 600 degrees C or more.

[Claim 4] Glass for substrates according to claim 1, 2, or 3 which is TL-T-four<50, using as T four (unit: degree C) temperature from which TL (unit: degree C) and viscosity are set to 104P in liquid phase temperature.

[Claim 5] The glass substrate for information record media which consists of glass for substrates according to claim 1, 2, 3, or 4.

[Claim 6] The glass substrate for information record media which exists in this glass substrate front face that is a glass substrate for information record media according to claim 5, and was held in the steam ambient atmosphere of 120 degrees C and two atmospheric pressures for 20 hours, whose magnitude the number of affixes 10 micrometers or more is two or less [per piece/cm] and whose number of 1-micrometer or more less than 10-micrometer affixes magnitude is two or less [105 //cm].

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] It is related with the glass for substrates this invention is excellent in weatherability, cannot break easily, and high [this invention] a glass transition point and suitable for the glass substrate used for flat-panel displays, such as a glass substrate used for information record media, such as glass for substrates suitable for mass production method, especially a magnetic disk, or a plasma display panel (PDP), and a field emission display (FED).

[0002]

[Description of the Prior Art] a glass substrate uses as the substrate for information record media, especially a substrate for magnetic disks (hard disk) — having — *** — the presentation of a mass-percentage display — SiO_2 :63.0%, aluminum 2O_3 :14.0%, ZrO_2 :7.0%, Li_2O :6.0%, and Na_2O :10.0% — the glass substrate which comes out and consists of a certain glass (henceforth "conventional glass") is illustrated. The glass substrate which consists of glass conventionally [this] is used usually carrying out chemical-strengthening processing. In addition, a content is expressed as this specification with mass percentage.

[0003]

[Problem(s) to be Solved by the Invention] the glass substrate for information record media — under the inventory — a front face — description changes remarkably and it is called for that film, such as substrate film formed on said glass substrate, a magnetic film, and a protective coat, becomes easy to peel, i.e., weatherability.

[0004] Although the weatherability of glass is by no means high conventionally [said], weatherability is set to the level permitted by chemical-strengthening processing. This is considered because extract removal of the alkali component considered to be the main factor to which the weatherability of glass is reduced conventionally is carried out by chemical-strengthening processing from a glass front face. However, there is a problem of dirt tending to adhere to the substrate front face after chemical-strengthening processing which a process increases in chemical-strengthening processing, and even if it does not perform chemical-strengthening processing, the glass substrate with good weatherability is called for. Moreover, the glass substrate which cannot break easily is called for.

[0005] On the other hand, since recording density is increased, making the coercive force of the magnetic layer which is a magnetic-recording layer increase is searched for. It is necessary to perform heat treatment performed on the occasion of magnetic layer formation for that purpose at higher temperature. From this viewpoint, it is called for that the glass transition point of the glass used for a substrate is high. In addition, the glass transition point of glass is 500 degrees C conventionally [said].

[0006] Although the glass substrate for magnetic disks had conventionally the main 2.5 mold substrate (glass-substrate outer diameter: 65mm) used for a notebook personal computer etc., possibility that a big substrate (glass-substrate outer diameter: 84mm), i.e., a 3.0 mold substrate, a 3.5 mold substrate (glass-substrate outer diameter: 95mm), etc. will increase is high rather than it is used for a server etc. from now on. Therefore, it is called for that the glass used for such a glass substrate fits mass production method.

[0007] Mass production method of glass is performed by the glass smelter. AZS (aluminum 2O_3 - ZrO_2 - SiO_2) system electrocast brick is usually used for the part which contacts the melting glass of a glass smelter, and directly. Therefore, it is called for that the erosiveness of the melting glass to AZS system electrocast brick is also small. Furthermore, mass production method of sheet glass is widely performed by the float glass process. Therefore, it is called for that it is glass in which float shaping is possible.

[0008] This invention aims at offer of the glass for substrates which solves the above-mentioned technical problem, and the glass substrate for information record media.

[0009]

[Means for Solving the Problem] Substantially this invention by mass-percentage display SiO_2 59 - 72%, aluminum 2O_3 1 - 15%, B $_2\text{O}_3$ 0 - 3%, MgO 0.5 - 9%, CaO 0.5 - 11%, SrO 0 - 6%, BaO 0 - 5%, TiO_2 0 - 6%, ZrO_2 0.5 - 10.5%, Li_2O 0 - 3%, Na_2O 0 - 9%, K_2O 4 - 21% — since — the sum total of the content of MgO , CaO , SrO , and BaO 4 to 19% The difference of the content of SiO_2 and the content of aluminum 2O_3 offers [the sum total of the content of Li_2O , Na_2O , and K_2O] the glass substrate for information record media with which specific gravity consists of glass for substrates which is less than 2.6, and said glass for substrates 50% or more 10 to 22%.

[0010]

[Embodiment of the Invention] The presentation of the glass for substrates of this invention (only henceforth the glass of this invention) is explained. SiO_2 is an indispensable component which forms the frame of glass. At less than 59%, the glass transition point when liquid phase temperature becomes high becomes low, or glass tends to get damaged and becomes. It is 60% or more preferably. By **, the solubility of glass falls 72%. It is 70% or less preferably.

[0011] aluminum 2O_3 is effective in raising weatherability and a glass transition point, and indispensable. At less than 1%, said effectiveness is small. It is 2% or more preferably. The liquid phase temperature to which the solubility of glass falls by ** 15% becomes high, or the erosiveness over AZS system electrocast brick becomes large. It is 12% or less preferably.

[0012] At less than 50%, a glass transition point becomes low too much, or it is easy to take lessons for a blemish from glass, and the difference of the content of SiO_2 and the content of aluminum 2O_3 becomes it. It is 51% or more preferably.

[0013] Although B $_2\text{O}_3$ is not indispensable, in order to raise the solubility of glass, or the stability of glass, you may contain to

3%. There is a possibility that a glass transition point may become low too much by ** 3%. It is 2% or less preferably.

[0014] MgO is effective in raising the solubility of glass, and indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, the liquid phase temperature of glass becomes high 9%, or glass tends to get damaged and becomes. It is 7% or less preferably.

[0015] CaO is effective in raising the solubility of glass, and indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, liquid phase temperature becomes high 11%, or glass tends to get damaged and becomes. It is 9% or less preferably.

[0016] Although SrO is not indispensable, in order to reduce liquid phase temperature and to raise the solubility of glass, you may contain to 6%. There is a possibility that glass may become easy to get damaged by ** 6%. It is 2% or less more preferably 4% or less.

[0017] Although BaO is not indispensable, in order to reduce liquid phase temperature and to raise the solubility of glass, you may contain to 5%. By **, weatherability falls 5%, or glass tends to get damaged and becomes. It is 2% or less preferably. As for BaO, not containing substantially is desirable to make it harder to get glass damaged when weatherability wants to improve more.

[0018] The solubility of glass falls [the sum total of the content of MgO, CaO, SrO, and BaO] at less than 4%, or liquid phase temperature becomes high too much. It is 10% or more 8% or more 6% or more preferably. By **, the liquid phase temperature of glass becomes high too much 19%, or glass tends to get damaged and becomes. It is 16% or less more preferably 17% or less.

[0019] Although TiO₂ is not indispensable, in order to raise the weatherability of glass, you may contain to 6%. By **, the liquid phase temperature of glass becomes high too much 6%, or glass tends to get damaged and becomes. It is 4% or less especially preferably 5% or less preferably.

[0020] ZrO₂ has the effectiveness which the weatherability of glass is raised and makes a glass transition point high, and is indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, liquid phase temperature becomes high too much 10.5%, or glass tends to get damaged and becomes. It is 5% or less preferably.

[0021] Although Li₂O is not indispensable, in order to raise the solubility of glass, you may contain to 3%. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 3% becomes large. It is 2% or less preferably. When weatherability wants to improve more and you want to make a glass transition point higher, it is desirable not to contain Li₂O substantially to control the erosiveness over AZS system electrocast brick more.

[0022] Although Na₂O is not indispensable, in order to raise the solubility of glass, you may contain to 9%. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 9% becomes large. It is 7% or less preferably.

[0023] K₂O is effective [raising the solubility of glass], and indispensable. At less than 4%, said effectiveness is small. It is 7% or more preferably. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 21% becomes large too much. It is 16% or less preferably.

[0024] The solubility of glass falls [the sum total of Li₂O, Na₂O, and K₂O] at less than 10%. It is 12% or more preferably. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 22% becomes large too much. It is 16% or less more preferably 17% or less.

[0025] Although the glass of this invention consists of the above-mentioned component substantially, other components may be contained in the range which does not spoil the purpose of this invention. As for the sum total of the content of the component of said others, it is desirable that it is 10% or less. It is 5% or less more preferably. The following is illustrated as a component of said others. The clarifier of SO₃, Cl, As₂O₃, and Sb₂O₃ grade may be contained to 1% in total. In order to acquire the same effectiveness as TiO₂, SnO₂ may be contained to 2%. In order to raise the solubility of glass, and stability, P₂O₅ and V₂O₅ grade may be contained to 3% in total.

[0026] As for the glass of this invention, it is desirable that the brittleness index value B (= Hv/Kc) acquired by *(ing) Vickers hardness number Hv with fracture toughness Kc is 1/2 or less [7400m -]. It is 1/2 or less [7300m -] more preferably.

[0027] As for the glass transition point of the glass of this invention, it is desirable that it is 600 degrees C or more. At less than 600 degrees C, heat treatment temperature for magnetic layer formation cannot be made high, but there is a possibility that it may become difficult to make the coercive force of a magnetic layer increase. It is 620 degrees C or more more preferably.

[0028] The glass of this invention makes temperature from which TL (unit: degree C) and its viscosity are set to 104P (poise) in the liquid phase temperature T four (unit: degree C), and it is desirable that it is TL-T-four<50. There is a possibility that float shaping may become difficult, in TL-T-four>=50. more — desirable — TL-T-four<40 — it is TL-T-four<30 especially preferably.

[0029] The glass of this invention is suitable for the glass substrate used for flat-panel displays used for information record media, such as a magnetic disk, such as a glass substrate, or PDP, FED.

[0030] The glass substrate for information record media of this invention (only henceforth the glass substrate of this invention) is a glass plate which consisted of glass of this invention and was cut by the predetermined dimension and configuration. When it holds in the steam ambient atmosphere of 120 degrees C and two atmospheric pressures for 20 hours, the magnitude which exists in this glass substrate front face is [the number NL of affixes 10 micrometers or more] two or less [per piece/cm], and, as for the glass substrate of this invention, it is desirable that magnitude is [the less than 10-micrometer 1 micrometer or more adhesion significant work NS] two or less [105 //cm].

[0031] One-piece [/cm] 2 super-**** has a possibility that film, such as substrate film with which NS occurs at a glass substrate front face, and an affix (white YAKE) is formed for it on a glass substrate during a glass substrate inventory, a magnetic film, and a protective coat, may become easy for NL to peel, in 105-piece [/cm] 2 **. It is thought that this affix is a resultant which carried out generation adhesion under the moisture in air or the effect of carbon dioxide gas at the glass substrate, and it is unremovable even if it wipes. NL is two or less [0.2 //cm] especially preferably two or less [0.5 //cm] more preferably. NS is two or less [0.6x105 //cm] especially preferably two or less [0.8x105 //cm] more preferably.

[0032] The glass of this invention and especially the manufacture approach of a glass substrate are not limited, but can apply various approaches. For example, the raw material of each component usually used is prepared so that it may become a target system, and heating fusion of this is carried out by the glass smelter. After homogenizing glass by bubbling, churning, addition of a clarifier, etc., fabricating to the glass plate of predetermined thickness by approaches, such as a well-known float glass process, the pressing method, the fusion method, and the down draw method, and processing grinding, polish, etc. if needed after annealing, it considers as the glass substrate of a predetermined dimension and configuration. Especially as a fabricating method,

the float glass process suitable for mass production method is suitable. The glass substrate of this invention is suitable for the glass substrate for magnetic disks.

[0033]

[Example] It prepared so that it might become the presentation which showed the raw material of each component to the column from SiO₂ to K₂O of a table by mass-percentage display, and it dissolved at the temperature of 1450–1550 degrees C for 3 to 5 hours using the platinum crucible. In the dissolution, the platinum stirrer was inserted into melting glass, it agitated for 2 hours, and glass was homogenized. Subsequently, it was being begun to pour melting glass, and fabricated and cooled slowly to tabular. In addition, MgCaSrBa shows the sum total of the content of MgO, CaO, SrO, and BaO, and LiNaK shows the sum total of the content of Li₂O, Na₂O, and K₂O for the value to which Si-aluminum of a table subtracted the content of aluminum 2O₃ from the content of SiO₂, respectively.

[0034] In this way, about the obtained glass plate, temperature T four (unit: degree C) from which specific gravity d, the brittleness index value B (unit: m^{-1/2}), glass transition point T_g (unit: degree C), the liquid phase temperature TL (unit: degree C), and viscosity are set to 104P, said NL (unit: piece/cm²), and said NS (unit: 105 piece/cm²) were measured by the approach shown below. A result is shown in a table. In addition, “—” shows to front Naka what did not measure.

[0035] d: about 20g glass lump which does not contain a bubble — using — Archimedes — it measured by law.

B: It asked for B not by the method of measuring Hv and Kc and asking for B but by the approach indicated by JP,10-152388,A 6 column of 27–40 lines. That is, when the Vickers indenter was pushed in, it asked for relational-expression $c/a=0.0056 B-2/3P^{1/6}$ to B of the magnitude (unit: micrometer) of the marks of the indenter which remains in a glass front face, and the die length (unit: micrometer) of the crack generated from the four corners of marks. Here, it is the die length (overall length of two symmetrical cracks containing the marks of an indenter) of the crack in which P generates the pushing force (unit: N) of the Vickers indenter, and a generates the diagonal length of the Vickers indentation, and c from the four corners of the Vickers indentation.

[0036] T_g: Temperature which measures to the temperature by which elongation is no longer observed already even if glass softens the elongation percentage of the glass at the time of carrying out a temperature up at 5 – degree C a rate for /from a room temperature by making quartz glass into a reference sample using a differential thermal expansion meter, i.e., a surrendering point, and is equivalent to the folding point in the obtained thermal expansion curve was made into the glass transition point.

TL: The mortar ground to the about 2mm glass grain, this glass grain was put on the platinum boat side by side, and glass was heat-treated in the temperature inclined coke oven for 24 hours. The peak price of the temperature of the glass grain with which the crystal deposits was made into liquid phase temperature.

[0037] T four: It measured with the rotational viscometer.

NL, NS: After carrying out mirror polishing of both sides of a glass plate whose thickness is 1–2mm and whose magnitude is 4cmx4cm and washing using a calcium carbonate and neutral detergent, it put into the super-accelerating life test machine (partial saturation mold pressure cooker TPC-410, Tabai Espec Corp. make), and put on the steam ambient atmosphere of 120 degrees C and two atmospheric pressures gently for 20 hours. The range of 200 micrometer angle of surface of the taken-out glass plate was observed with the differential interference microscope, and the number and magnitude of an affix of 10 micrometers or more counted [magnitude] the number of 1-micrometer or more less than 10-micrometer affix.

[0038] The glass of an example and Example 24 is glass conventionally [said], and the glass of Examples 1–23 is an example of a comparison.

[0039]

[Table 1]

	例 1	例 2	例 3	例 4	例 5	例 6	例 7	例 8	例 9	例 10
SiO ₂	59.9	63.0	62.2	68.8	61.0	64.0	68.4	62.7	63.0	60.5
Al ₂ O ₃	8.0	3.8	9.6	2.5	9.2	11.2	2.8	7.9	7.3	7.1
B ₂ O ₃	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MgO	3.2	4.3	4.6	5.8	2.4	3.8	4.5	0.6	8.7	4.5
CaO	6.7	9.2	6.4	9.0	3.4	5.3	6.3	10.4	0.9	6.3
SrO	3.7	0.0	2.8	0.4	3.1	0.0	0.0	1.6	3.3	1.6
BaO	0.0	0.0	0.0	1.3	0.0	2.4	3.1	0.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	3.0	3.4	1.7	1.3	4.4	1.0	2.1	2.9	2.1	4.1
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	2.8	1.0	5.3	4.3	8.8	8.2	4.9	5.5	5.7	2.9
K ₂ O	13.2	15.3	7.4	6.6	9.9	4.1	7.9	8.4	9.0	13.0
Si-Al	51.9	59.2	52.6	66.8	51.8	52.8	65.6	54.8	55.7	53.4
MgCaSrBa	13.6	13.5	13.8	16.5	8.9	11.5	13.9	12.6	12.9	12.4
LiNaK	15.5	16.3	12.7	10.9	16.5	12.3	12.8	13.9	14.7	15.9
d	2.58	2.55	2.55	2.53	2.57	2.53	2.53	2.56	2.53	2.58
E	7400	7200	7200	7200	7300	7200	7200	7200	7300	7400
T _g	689	682	648	634	667	662	646	667	642	682
T _L	1120	—	—	—	—	—	1120	—	—	1100
T ₊	1171	—	—	1120	—	—	1166	—	—	1165
N _L	—	—	—	—	—	—	—	—	—	—
N _S	—	—	—	—	—	—	—	—	—	—

[0040]
[Table 2]

	例 11	例 12	例 13	例 14	例 15	例 16	例 17	例 18	例 19	例 20
SiO ₂	61.7	71.3	64.6	60.6	59.3	65.2	64.8	63.4	63.6	63.7
Al ₂ O ₃	9.4	1.3	2.4	3.5	3.5	4.0	4.0	3.9	4.0	1.8
B ₂ O ₃	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
MgO	3.6	4.4	3.7	4.5	4.5	4.4	4.4	4.0	3.5	3.8
CaO	4.9	9.3	6.0	3.4	3.4	7.0	7.0	4.5	4.5	4.5
SrO	1.6	0.0	0.0	1.0	1.0	0.0	0.0	5.5	6.0	0.0
BaO	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	2.9	0.7	4.7	6.5	6.5	3.4	3.4	0.7	2.0	10.2
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	5.7	8.3	0.5	0.0	0.0	2.0	1.0	0.0	0.5	0.0
K ₂ O	9.0	4.7	18.1	20.5	20.5	14.0	15.4	14.0	15.9	16.0
Si-Al	52.3	70.0	62.2	57.1	55.8	61.2	60.8	59.5	59.6	61.9
MgCaSrBa	11.3	13.7	9.7	8.9	8.9	11.4	11.4	18.0	14.0	8.3
LiNaK	14.7	13.0	18.6	20.5	20.5	16.0	16.4	14.0	16.4	16.0
d	2.55	2.47	2.52	2.55	2.55	2.52	2.51	2.59	2.55	2.58
B	7300	7100	7200	7300	7300	7200	7100	7300	7300	7350
T _g	665	612	672	672	672	667	663	631	642	672
T _L	—	—	1130	—	—	1140	1130	—	—	—
T ₊	—	—	1205	1214	1170	1192	1205	—	—	—
N _L	—	—	—	—	—	—	—	—	—	—
N _S	—	—	—	—	—	—	—	—	—	—

[0041]
[Table 3]

	例 21	例 22	例 23	例 24
SiO ₂	59.8	60.9	60.9	63.0
Al ₂ O ₃	9.6	9.5	9.5	14.0
B ₂ O ₃	0.0	0.0	0.0	0.0
MgO	5.0	5.0	5.0	0.0
CaO	6.3	6.1	6.1	0.0
SrO	2.1	1.6	1.6	0.0
BaO	0.0	0.0	0.0	0.0
TiO ₂	0.0	1.0	0.0	0.0
ZrO ₂	3.2	1.5	2.5	7.0
Li ₂ O	0.0	1.0	0.0	6.0
Na ₂ O	4.8	3.9	4.9	10.0
K ₂ O	9.2	9.5	9.5	0.0
Si—Al	50.2	51.4	51.4	49.0
MgCaSrBa	13.4	12.7	12.7	0.0
LiNaK	14.0	14.4	14.4	16.0
d	2.58	2.57	2.55	2.52
E	7300	7300	7300	—
T _g	662	630	645	600
T _L	1160	—	1190	—
T _d	1170	—	1175	—
N _L	0	0	0	2×10 ⁴
N _S	0.3	0.4	0.3	4.0

[0042]

[Effect of the Invention] According to this invention, it excels in weatherability and is hard to be divided, a glass transition point is high, and the glass substrate used for flat displays used for information record media, such as a glass substrate suitable for mass production method, especially a magnetic disk, such as a glass substrate, and PDP, FED, can be offered, without performing chemical-strengthening processing.

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TECHNICAL FIELD

[Field of the Invention] It is related with the glass for substrates this invention is excellent in weatherability, cannot break easily, and high [this invention] a glass transition point and suitable for the glass substrate used for flat-panel displays, such as a glass substrate used for information record media, such as glass for substrates suitable for mass production method, especially a magnetic disk, or a plasma display panel (PDP), and a field emission display (FED).

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PRIOR ART

[Description of the Prior Art] a glass substrate uses as the substrate for information record media, especially a substrate for magnetic disks (hard disk) — having — *** — the presentation of a mass-percentage display — SiO₂:63.0%, aluminum₂O₃:14.0%, ZrO₂:7.0%, Li₂O:6.0%, and Na₂ — the glass substrate which comes out and consists of a certain glass (henceforth "conventional glass") O:10.0% is illustrated. The glass substrate which consists of glass conventionally [this] is used usually carrying out chemical-strengthening processing. In addition, a content is expressed as this specification with mass percentage.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, it excels in weatherability and is hard to be divided, a glass transition point is high, and the glass substrate used for flat displays used for information record media, such as a glass substrate suitable for mass production method, especially a magnetic disk, such as a glass substrate, and PDP, FED, can be offered, without performing chemical-strengthening processing.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] the glass substrate for information record media — under the inventory — a front face — description changes remarkably and it is called for that film, such as substrate film formed on said glass substrate, a magnetic film, and a protective coat, becomes easy to peel, i.e., weatherability.

[0004] Although the weatherability of glass is by no means high conventionally [said], weatherability is set to the level permitted by chemical-strengthening processing. This is considered because extract removal of the alkali component considered to be the main factor to which the weatherability of glass is reduced conventionally is carried out by chemical-strengthening processing from a glass front face. However, there is a problem of dirt tending to adhere to the substrate front face after chemical-strengthening processing which a process increases in chemical-strengthening processing, and even if it does not perform chemical-strengthening processing, the glass substrate with good weatherability is called for. Moreover, the glass substrate which cannot break easily is called for.

[0005] On the other hand, since recording density is increased, making the coercive force of the magnetic layer which is a magnetic-recording layer increase is searched for. It is necessary to perform heat treatment performed on the occasion of magnetic layer formation for that purpose at higher temperature. From this viewpoint, it is called for that the glass transition point of the glass used for a substrate is high. In addition, the glass transition point of glass is 500 degrees C conventionally [said].

[0006] Although the glass substrate for magnetic disks had conventionally the main 2.5 mold substrate (glass-substrate outer diameter: 65mm) used for a notebook personal computer etc., possibility that a big substrate (glass-substrate outer diameter: 84mm), i.e., a 3.0 mold substrate, a 3.5 mold substrate (glass-substrate outer diameter: 95mm), etc. will increase is high rather than it is used for a server etc. from now on. Therefore, it is called for that the glass used for such a glass substrate fits mass production method.

[0007] Mass production method of glass is performed by the glass smelter. AZS (aluminum2O3-ZrO2-SiO2) system electrocast brick is usually used for the part which contacts the melting glass of a glass smelter, and directly. Therefore, it is called for that the erosiveness of the melting glass to AZS system electrocast brick is also small. Furthermore, mass production method of sheet glass is widely performed by the float glass process. Therefore, it is called for that it is glass in which float shaping is possible.

[0008] This invention aims at offer of the glass for substrates which solves the above-mentioned technical problem, and the glass substrate for information record media.

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MEANS

[Means for Solving the Problem] Substantially this invention by mass-percentage display SiO₂ 59 - 72%, aluminum 2O₃ 1 - 15%, B-2 O₃ 0 - 3%, MgO 0.5 - 9%, CaO 0.5 - 11%, SrO 0 - 6%, BaO 0 - 5%, TiO₂ 0 - 6%, ZrO₂ 0.5 - 10.5%, Li₂O 0 - 3%, Na₂O 0 - 9%, K₂O 4 - 21% — since — the sum total of the content of MgO, CaO, SrO, and BaO 4 to 19% The difference of the content of SiO₂ and the content of aluminum 2O₃ offers [the sum total of the content of Li₂O, Na₂O, and K₂O] the glass substrate for information record media with which specific gravity consists of glass for substrates which is less than 2.6, and said glass for substrates 50% or more 10 to 22%.

[0010]

[Embodiment of the Invention] The presentation of the glass for substrates of this invention (only henceforth the glass of this invention) is explained. SiO₂ is an indispensable component which forms the frame of glass. At less than 59%, the glass transition point when liquid phase temperature becomes high becomes low, or glass tends to get damaged and becomes. It is 60% or more preferably. By **, the solubility of glass falls 72%. It is 70% or less preferably.

[0011] aluminum 2O₃ is effective in raising weatherability and a glass transition point, and indispensable. At less than 1%, said effectiveness is small. It is 2% or more preferably. The liquid phase temperature to which the solubility of glass falls by ** 15% becomes high, or the erosiveness over AZS system electrocast brick becomes large. It is 12% or less preferably.

[0012] At less than 50%, a glass transition point becomes low too much, or it is easy to take lessons for a blemish from glass, and the difference of the content of SiO₂ and the content of aluminum 2O₃ becomes it. It is 51% or more preferably.

[0013] Although B-2 O₃ is not indispensable, in order to raise the solubility of glass, or the stability of glass, you may contain to 3%. There is a possibility that a glass transition point may become low too much by ** 3%. It is 2% or less preferably.

[0014] MgO is effective in raising the solubility of glass, and indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, the liquid phase temperature of glass becomes high 9%, or glass tends to get damaged and becomes. It is 7% or less preferably.

[0015] CaO is effective in raising the solubility of glass, and indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, liquid phase temperature becomes high 11%, or glass tends to get damaged and becomes. It is 9% or less preferably.

[0016] Although SrO is not indispensable, in order to reduce liquid phase temperature and to raise the solubility of glass, you may contain to 6%. There is a possibility that glass may become easy to get damaged by ** 6%. It is 2% or less more preferably 4% or less.

[0017] Although BaO is not indispensable, in order to reduce liquid phase temperature and to raise the solubility of glass, you may contain to 5%. By **, weatherability falls 5%, or glass tends to get damaged and becomes. It is 2% or less preferably. As for BaO, not containing substantially is desirable to make it harder to get glass damaged when weatherability wants to improve more.

[0018] The solubility of glass falls [the sum total of the content of MgO, CaO, SrO, and BaO] at less than 4%, or liquid phase temperature becomes high too much. It is 10% or more 8% or more 6% or more preferably. By **, the liquid phase temperature of glass becomes high too much 19%, or glass tends to get damaged and becomes. It is 16% or less more preferably 17% or less.

[0019] Although TiO₂ is not indispensable, in order to raise the weatherability of glass, you may contain to 6%. By **, the liquid phase temperature of glass becomes high too much 6%, or glass tends to get damaged and becomes. It is 4% or less especially preferably 5% or less preferably.

[0020] ZrO₂ has the effectiveness which the weatherability of glass is raised and makes a glass transition point high, and is indispensable. At less than 0.5%, said effectiveness is small. It is 2% or more preferably. By **, liquid phase temperature becomes high too much 10.5%, or glass tends to get damaged and becomes. It is 5% or less preferably.

[0021] Although Li₂O is not indispensable, in order to raise the solubility of glass, you may contain to 3%. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 3% becomes large. It is 2% or less preferably. When weatherability wants to improve more and you want to make a glass transition point higher, it is desirable not to contain Li₂O substantially to control the erosiveness over AZS system electrocast brick more.

[0022] Although Na₂O is not indispensable, in order to raise the solubility of glass, you may contain to 9%. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 9% becomes large. It is 7% or less preferably.

[0023] K₂O is effective [raising the solubility of glass], and indispensable. At less than 4%, said effectiveness is small. It is 7% or more preferably. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 21% becomes large too much. It is 16% or less preferably.

[0024] The solubility of glass falls [the sum total of Li₂O, Na₂O, and K₂O] at less than 10%. It is 12% or more preferably. The erosiveness [as opposed to / become / a glass transition point / low too much or / AZS system electrocast brick] to which the weatherability of glass falls remarkably by ** 22% becomes large too much. It is 16% or less more preferably 17% or less.

[0025] Although the glass of this invention consists of the above-mentioned component substantially, other components may be contained in the range which does not spoil the purpose of this invention. As for the sum total of the content of the component of said others, it is desirable that it is 10% or less. It is 5% or less more preferably. The following is illustrated as a component of said others. The clarifier of SO₃, Cl, As 2O₃, and Sb₂O₃ grade may be contained to 1% in total. In order to acquire the same

effectiveness as TiO_2 , SnO_2 may be contained to 2%. In order to raise the solubility of glass, and stability, P_2O_5 and V_2O_5 grade may be contained to 3% in total.

[0026] As for the glass of this invention, it is desirable that the brittleness index value $B (= H_v/K_c)$ acquired by H_v (Vickers hardness number H_v with fracture toughness K_c is $1/2$ or less [7400m -]. It is $1/2$ or less [7300m -] more preferably.

[0027] As for the glass transition point of the glass of this invention, it is desirable that it is 600 degrees C or more. At less than 600 degrees C, heat treatment temperature for magnetic layer formation cannot be made high, but there is a possibility that it may become difficult to make the coercive force of a magnetic layer increase. It is 620 degrees C or more more preferably.

[0028] The glass of this invention makes temperature from which TL (unit: degree C) and its viscosity are set to 104P (poise) in the liquid phase temperature T four (unit: degree C), and it is desirable that it is $TL - T_{\text{four}} < 50$. There is a possibility that float shaping may become difficult, in $TL - T_{\text{four}} \geq 50$. more — desirable — $TL - T_{\text{four}} < 40$ — it is $TL - T_{\text{four}} < 30$ especially preferably.

[0029] The glass of this invention is suitable for the glass substrate used for flat-panel displays used for information record media, such as a magnetic disk, such as a glass substrate, or PDP, FED.

[0030] The glass substrate for information record media of this invention (only henceforth the glass substrate of this invention) is a glass plate which consisted of glass of this invention and was cut by the predetermined dimension and configuration. When it holds in the steam ambient atmosphere of 120 degrees C and two atmospheric pressures for 20 hours, the magnitude which exists in this glass substrate front face is [the number NL of affixes 10 micrometers or more] two or less [per piece/cm], and, as for the glass substrate of this invention, it is desirable that magnitude is [the less than 10-micrometer 1 micrometer or more adhesion significant work NS] two or less [105 //cm].

[0031] One-piece [/cm] 2 super-**** has a possibility that film, such as substrate film with which NS occurs at a glass substrate front face, and an affix (white YAKE) is formed for it on a glass substrate during a glass substrate inventory, a magnetic film, and a protective coat, may become easy for NL to peel, in 105-piece [/cm] 2 **. It is thought that this affix is a resultant which carried out generation adhesion under the moisture in air or the effect of carbon dioxide gas at the glass substrate, and it is unremovable even if it wipes. NL is two or less [0.2 //cm] especially preferably two or less [0.5 //cm] more preferably. NS is two or less [0.6×10^5 //cm] especially preferably two or less [0.8×10^5 //cm] more preferably.

[0032] The glass of this invention and especially the manufacture approach of a glass substrate are not limited, but can apply various approaches. For example, the raw material of each component usually used is prepared so that it may become a target system, and heating fusion of this is carried out by the glass smelter. After homogenizing glass by bubbling, churning, addition of a clarifier, etc., fabricating to the glass plate of predetermined thickness by approaches, such as a well-known float glass process, the pressing method, the fusion method, and the down draw method, and processing grinding, polish, etc. if needed after annealing, it considers as the glass substrate of a predetermined dimension and configuration. Especially as a fabricating method, the float glass process suitable for mass production method is suitable. The glass substrate of this invention is suitable for the glass substrate for magnetic disks.

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EXAMPLE

[Example] It prepared so that it might become the presentation which showed the raw material of each component to the column from SiO₂ to K₂O of a table by mass-percentage display, and it dissolved at the temperature of 1450–1550 degrees C for 3 to 5 hours using the platinum crucible. In the dissolution, the platinum stirrer was inserted into melting glass, it agitated for 2 hours, and glass was homogenized. Subsequently, it was being begun to pour melting glass, and fabricated and cooled slowly to tabular. In addition, MgCaSrBa shows the sum total of the content of MgO, CaO, SrO, and BaO, and LiNaK shows the sum total of the content of Li₂O, Na₂O, and K₂O for the value to which Si-aluminum of a table subtracted the content of aluminum 2O₃ from the content of SiO₂, respectively.

[0034] In this way, about the obtained glass plate, temperature T four (unit: degree C) from which specific gravity d, the brittleness index value B (unit: m^{-1/2}), glass transition point T_g (unit: degree C), the liquid phase temperature TL (unit: degree C), and viscosity are set to 104P, said NL (unit: piece/cm²), and said NS (unit: 105 piece/cm²) were measured by the approach shown below. A result is shown in a table. In addition, “—” shows to front Naka what did not measure.

[0035] d: about 20g glass lump which does not contain a bubble — using — Archimedes — it measured by law.

B: It asked for B not by the method of measuring Hv and Kc and asking for B but by the approach indicated by JP,10-152388,A 6 column of 27-40 lines. That is, when the Vickers indenter was pushed in, it asked for relational-expression $c/a=0.0056 B-2/3P^{1/6}$ to B of the magnitude (unit: micrometer) of the marks of the indenter which remains in a glass front face, and the die length (unit: micrometer) of the crack generated from the four corners of marks. Here, it is the die length (overall length of two symmetrical cracks containing the marks of an indenter) of the crack in which P generates the pushing force (unit: N) of the Vickers indenter, and a generates the diagonal length of the Vickers indentation, and c from the four corners of the Vickers indentation.

[0036] T_g: Temperature which measures to the temperature by which elongation is no longer observed already even if glass softens the elongation percentage of the glass at the time of carrying out a temperature up at 5 – degree C a rate for /from a room temperature by making quartz glass into a reference sample using a differential thermal expansion meter, i.e., a surrendering point, and is equivalent to the folding point in the obtained thermal expansion curve was made into the glass transition point.

TL: The mortar ground to the about 2mm glass grain, this glass grain was put on the platinum boat side by side, and glass was heat-treated in the temperature inclined coke oven for 24 hours. The peak price of the temperature of the glass grain with which the crystal deposits was made into liquid phase temperature.

[0037] T four: It measured with the rotational viscometer.

NL, NS: After carrying out mirror polishing of both sides of a glass plate whose thickness is 1–2mm and whose magnitude is 4cmx4cm and washing using a calcium carbonate and neutral detergent, it put into the super-accelerating life test machine (partial saturation mold pressure cooker TPC-410, Tabai Espec Corp. make), and put on the steam ambient atmosphere of 120 degrees C and two atmospheric pressures gently for 20 hours. The range of 200 micrometer angle of surface of the taken-out glass plate was observed with the differential interference microscope, and the number and magnitude of an affix of 10 micrometers or more counted [magnitude] the number of 1-micrometer or more less than 10-micrometer affix.

[0038] The glass of an example and Example 24 is glass conventionally [said], and the glass of Examples 1-23 is an example of a comparison.

[0039]

[Table 1]

	例 1	例 2	例 3	例 4	例 5	例 6	例 7	例 8	例 9	例 10
SiO ₂	59.9	63.0	62.2	68.8	61.0	64.0	68.4	62.7	63.0	60.5
Al ₂ O ₃	8.0	3.8	9.6	2.5	9.2	11.2	2.8	7.9	7.3	7.1
B ₂ O ₃	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MgO	3.2	4.3	4.6	5.8	2.4	3.8	4.5	0.6	8.7	4.5
CaO	6.7	9.2	6.4	9.0	3.4	5.3	6.3	10.4	0.9	6.3
SrO	3.7	0.0	2.8	0.4	3.1	0.0	0.0	1.6	3.3	1.6
BaO	0.0	0.0	0.0	1.3	0.0	2.4	3.1	0.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	3.0	3.4	1.7	1.3	4.4	1.0	2.1	2.9	2.1	4.1
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	2.3	1.0	5.3	4.3	8.8	8.2	4.9	5.5	5.7	2.9
K ₂ O	13.2	15.3	7.4	6.6	9.9	4.1	7.9	8.4	9.0	13.0
Si-Al	51.9	59.2	52.6	66.8	51.8	52.8	65.6	54.8	55.7	53.4
MgCaSrBa	13.6	13.5	13.8	16.5	8.9	11.5	13.9	12.6	12.9	12.4
LiNaK	15.5	16.3	12.7	10.9	16.5	12.3	12.8	13.9	14.7	15.9
d	2.58	2.55	2.55	2.53	2.57	2.53	2.53	2.56	2.53	2.58
E	7400	7200	7200	7200	7300	7200	7200	7200	7300	7400
T _g	689	682	648	634	667	652	646	657	642	682
T _L	1120	—	—	—	—	—	1120	—	—	1100
T ₊	1171	—	—	1120	—	—	1156	—	—	1165
N _L	—	—	—	—	—	—	—	—	—	—
N _S	—	—	—	—	—	—	—	—	—	—

[0040]

[Table 2]

	例 11	例 12	例 13	例 14	例 15	例 16	例 17	例 18	例 19	例 20
SiO ₂	61.7	71.3	64.6	60.6	59.3	65.2	64.8	63.4	63.6	63.7
Al ₂ O ₃	9.4	1.3	2.4	3.5	3.5	4.0	4.0	3.9	4.0	1.8
B ₂ O ₃	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
MgO	3.6	4.4	3.7	4.5	4.5	4.4	4.4	4.0	3.5	3.8
CaO	4.9	9.3	6.0	3.4	3.4	7.0	7.0	4.5	4.5	4.5
SrO	1.6	0.0	0.0	1.0	1.0	0.0	0.0	5.5	6.0	0.0
BaO	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	2.9	0.7	4.7	6.5	6.5	3.4	3.4	0.7	2.0	10.2
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	5.7	8.3	0.5	0.0	0.0	2.0	1.0	0.0	0.5	0.0
K ₂ O	9.0	4.7	18.1	20.5	20.5	14.0	15.4	14.0	15.9	16.0
Si-Al	52.3	70.0	62.2	57.1	55.8	61.2	60.8	59.5	59.6	61.9
MgCaSrBa	11.3	13.7	9.7	8.9	8.9	11.4	11.4	18.0	14.0	8.3
LiNaK	14.7	13.0	18.6	20.5	20.5	16.0	16.4	14.0	16.4	16.0
d	2.55	2.47	2.52	2.55	2.55	2.52	2.51	2.59	2.55	2.58
B	7300	7100	7200	7300	7300	7200	7100	7300	7300	7350
T _g	665	612	672	672	672	667	663	631	642	672
T _L	—	—	1130	—	—	1140	1130	—	—	—
T ₄	—	—	1205	1214	1170	1192	1205	—	—	—
N _L	—	—	—	—	—	—	—	—	—	—
N _S	—	—	—	—	—	—	—	—	—	—

[0041]

[Table 3]

	例 21	例 22	例 23	例 24
SiO ₂	59.8	60.9	60.9	63.0
Al ₂ O ₃	9.6	9.5	9.5	14.0
B ₂ O ₃	0.0	0.0	0.0	0.0
MgO	5.0	5.0	5.0	0.0
CaO	6.3	6.1	6.1	0.0
SrO	2.1	1.6	1.6	0.0
BaO	0.0	0.0	0.0	0.0
TiO ₂	0.0	1.0	0.0	0.0
ZrO ₂	3.2	1.5	2.5	7.0
Li ₂ O	0.0	1.0	0.0	6.0
Na ₂ O	4.8	3.9	4.9	10.0
K ₂ O	9.2	9.5	9.5	0.0
Si-Al	50.2	51.4	51.4	49.0
MgCaSrBa	13.4	12.7	12.7	0.0
LiNaK	14.0	14.4	14.4	16.0
d	2.58	2.57	2.55	2.52
B	7300	7300	7300	—
T _s	652	630	645	500
T ₁	1160	—	1190	—
T ₂	1170	—	1175	—
N ₁	0	0	0	2×10 ⁴
N _s	0.3	0.4	0.3	4.0

[Translation done.]

(8) JP, 1-294441, A

(19) 日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開2001-294441

(P 2 0 0 1 - 2 9 4 4 4 1 A)

(43) 公開日 平成13年10月23日 (2001.10.23)

(51) Int. Cl. ⁷	識別記号	F I	テーマコード (参考)
C03C 3/093		C03C 3/093	4G062
		3/087	5C094
G09F 9/30	310	G09F 9/30	5D006
G11B 5/73		G11B 5/73	

審査請求 未請求 請求項の数 6 O L (全 7 頁)

(21) 出願番号 特願2000-109803 (P 2000-109803)

(22) 出願日 平成12年 4 月 11 日 (2000. 4. 11)

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最終頁に続く

(54) 【発明の名称】 基板用ガラス

(57) 【要約】

【課題】 割れにくく、高耐候性、高ガラス転移点、大量生産向き基板用ガラスの提供。

【解決手段】 質量百分率で、 SiO_2 : 59~72、 Al_2O_3 : 1~15、 MgO : 0.5~9、 CaO : 0.5~11、 SrO : 0~6、 ZrO_2 : 0.5~10.5、 K_2O : 4~21、 $\text{MgO}+\text{CaO}+\text{SrO}+\text{BaO}$: 4~19、 $\text{Li}_2\text{O}+\text{Na}_2\text{O}+\text{K}_2\text{O}$: 10~22、 $\text{SiO}_2-\text{Al}_2\text{O}_3 \geq 50$ 等からなり、比重<2.6の基板用ガラス。

【特許請求の範囲】

【請求項1】質量百分率表示で実質的に、

SiO ₂	59～72 %、
Al ₂ O ₃	1～15 %、
B ₂ O ₃	0～3 %、
MgO	0.5～9 %、
CaO	0.5～11 %、
SrO	0～6 %、
BaO	0～5 %、
TiO ₂	0～6 %、
ZrO ₂	0.5～10.5 %、
Li ₂ O	0～3 %、
Na ₂ O	0～9 %、
K ₂ O	4～21 %、

からなり、MgO、CaO、SrOおよびBaOの含有量の合計が4～19 %、Li₂O、Na₂OおよびK₂Oの含有量の合計が10～22 %、SiO₂の含有量とAl₂O₃の含有量の差が50 %以上、比重が2.6未満である基板用ガラス。

【請求項2】脆さ指標値Bが7400 m^{-1/2}以下である請求項1に記載の基板用ガラス。

【請求項3】ガラス転移点が600℃以上である請求項1または2に記載の基板用ガラス。

【請求項4】液相温度をT_L（単位：℃）、粘度が10⁴ Pとなる温度をT_V（単位：℃）として、T_L-T_V<50である請求項1、2または3に記載の基板用ガラス。

【請求項5】請求項1、2、3または4に記載の基板用ガラスからなる情報記録媒体用ガラス基板。

【請求項6】請求項5に記載の情報記録媒体用ガラス基板であって、120℃、2気圧の水蒸気雰囲気中に20時間保持した該ガラス基板表面に存在する、大きさが10 μm以上の付着物の数が1個/cm²以下であり、大きさが1 μm以上10 μm未満の付着物の数が10⁵個/cm²以下である情報記録媒体用ガラス基板。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、耐候性に優れ、割れにくく、ガラス転移点が高く、また大量生産に適した基板用ガラス、特に磁気ディスク等の情報記録媒体に用いられるガラス基板またはプラズマディスプレイパネル（PDP）、フィールドエミッションディスプレイ（FED）等のフラットパネルディスプレイに用いられるガラス基板に好適な基板用ガラスに関する。

【0002】

【従来の技術】情報記録媒体用基板、特に磁気ディスク（ハードディスク）用基板としてガラス基板が用いられ、質量百分率表示の組成が、SiO₂：63.0 %、Al₂O₃：14.0 %、ZrO₂：7.0 %、Li₂O：6.0 %、Na₂O：10.0 %、であるガラス

（以下「従来ガラス」という。）からなるガラス基板が

例示される。この従来ガラスからなるガラス基板は通常化学強化処理されて使用される。なお、本明細書では含有量は質量百分率で表示する。

【0003】

【発明が解決しようとする課題】情報記録媒体用ガラス基板には、その在庫中に表面性状が著しく変化し、前記ガラス基板上に形成される下地膜、磁性膜、保護膜等の膜のはがれやすくなることがないこと、すなわち耐候性が求められる。

10 【0004】前記従来ガラスの耐候性は決して高くはないが、化学強化処理によって耐候性は許容されるレベルになる。これは、従来ガラスの耐候性を低下させる主因と考えられるアルカリ成分が、化学強化処理によってガラス表面から抽出除去されるためと考えられる。しかし化学強化処理には、工程が増加する、化学強化処理後の基板表面によごれが付着しやすい等の問題があり、化学強化処理を行わなくとも耐候性が良好なガラス基板が求められている。また、割れにくいガラス基板が求められている。

20 【0005】一方、記憶密度を増すために磁気記録層である磁性層の保磁力を増加させることが求められている。そのためには磁性層形成に際して行われる熱処理をより高い温度で行う必要がある。この観点から、基板に用いられるガラスのガラス転移点が高いことが求められている。なお、前記従来ガラスのガラス転移点は500℃である。

【0006】磁気ディスク用ガラス基板は従来、ノートブックパソコン等に用いられる2.5型基板（ガラス基板外径：65mm）が主であったが、今後はサーバー等に用いられるより大きな基板、すなわち3.0型基板（ガラス基板外径：84mm）、3.5型基板（ガラス基板外径：95mm）等も増加する可能性が高い。したがって、このようなガラス基板に使用されるガラスは大量生産に適したものであることが求められている。

【0007】ガラスの大量生産はガラス溶融窯により行われる。ガラス溶融窯の溶融ガラスと直接接触する部分には通常AZS（Al₂O₃-ZrO₂-SiO₂）系電鍍煉瓦が使用される。したがって、AZS系電鍍煉瓦に対する溶融ガラスの侵食性が小さいことも求められている。さらに、板ガラスの大量生産はフロート法により広く行われている。したがって、フロート成形が可能なガラスであることが求められている。

【0008】本発明は、上記課題を解決する基板用ガラスおよび情報記録媒体用ガラス基板の提供を目的とする。

【0009】

【課題を解決するための手段】本発明は、質量百分率表示で実質的に、

SiO ₂	59～72 %、
Al ₂ O ₃	1～15 %、

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B_2O_3	0 ~ 3 %、
MgO	0. 5 ~ 9 %、
CaO	0. 5 ~ 1 1 %、
SrO	0 ~ 6 %、
BaO	0 ~ 5 %、
TiO_2	0 ~ 6 %、
ZrO_2	0. 5 ~ 1 0. 5 %、
Li_2O	0 ~ 3 %、
Na_2O	0 ~ 9 %、
K_2O	4 ~ 2 1 %、

からなり、 MgO 、 CaO 、 SrO および BaO の含有量の合計が4 ~ 1 9 %、 Li_2O 、 Na_2O および K_2O の含有量の合計が1 0 ~ 2 2 %、 SiO_2 の含有量と Al_2O_3 の含有量の差が5 0 %以上、比重が2. 6未満である基板用ガラス、および、前記基板用ガラスからなる情報記録媒体用ガラス基板を提供する。

【0 0 1 0】

【発明の実施の形態】本発明の基板用ガラス（以下単に本発明のガラスという。）の組成について説明する。 SiO_2 はガラスの骨格を形成する必須成分である。5 9 %未満では液相温度が高くなる、ガラス転移点が低くなる、またはガラスが傷つきやすくなる。好ましくは6 0 %以上である。7 2 %超ではガラスの溶解性が低下する。好ましくは7 0 %以下である。

【0 0 1 1】 Al_2O_3 は耐候性およびガラス転移点を向上させる効果があり、必須である。1 %未満では前記効果が小さい。好ましくは2 %以上である。1 5 %超ではガラスの溶解性が低下する、液相温度が高くなる、またはA Z S系電鍍煉瓦に対する侵食性が大きくなる。好ましくは1 2 %以下である。

【0 0 1 2】 SiO_2 の含有量と Al_2O_3 の含有量との差が5 0 %未満では、ガラス転移点が低くなりすぎる、またはガラスに傷がつきやすくなる。好ましくは5 1 %以上である。

【0 0 1 3】 B_2O_3 は必須ではないが、ガラスの溶解性またはガラスの安定性を向上させるために3 %まで含有してもよい。3 %超ではガラス転移点が低くなりすぎるおそれがある。好ましくは2 %以下である。

【0 0 1 4】 MgO はガラスの溶解性を向上させる効果があり、必須である。0. 5 %未満では前記効果が小さい。好ましくは2 %以上である。9 %超ではガラスの液相温度が高くなる、またはガラスが傷つきやすくなる。好ましくは7 %以下である。

【0 0 1 5】 CaO はガラスの溶解性を向上させる効果があり、必須である。0. 5 %未満では前記効果が小さい。好ましくは2 %以上である。1 1 %超では液相温度が高くなる、またはガラスが傷つきやすくなる。好ましくは9 %以下である。

【0 0 1 6】 SrO は必須ではないが、液相温度を低下させ、またガラスの溶解性を向上させるために6 %まで

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含有してもよい。6 %超ではガラスが傷つきやすくなるおそれがある。好ましくは4 %以下、より好ましくは2 %以下である。

【0 0 1 7】 BaO は必須ではないが、液相温度を低下させ、またガラスの溶解性を向上させるために5 %まで含有してもよい。5 %超では耐候性が低下する、またはガラスが傷つきやすくなる。好ましくは2 %以下である。耐候性をより向上させたい場合、またはガラスをより傷付きにくくしたい場合、 BaO は実質的に含有しないことが好ましい。

【0 0 1 8】 MgO 、 CaO 、 SrO および BaO の含有量の合計が4 %未満では、ガラスの溶解性が低下する、または液相温度が高くなりすぎる。好ましくは6 %以上、より好ましくは8 %以上、最も好ましくは1 0 %以上である。1 9 %超ではガラスの液相温度が高くなりすぎる、またはガラスが傷つきやすくなる。好ましくは1 7 %以下、より好ましくは1 6 %以下である。

【0 0 1 9】 TiO_2 は必須ではないが、ガラスの耐候性を向上させるために6 %まで含有してもよい。6 %超ではガラスの液相温度が高くなりすぎる、またはガラスが傷つきやすくなる。好ましくは5 %以下、特に好ましくは4 %以下である。

【0 0 2 0】 ZrO_2 はガラスの耐候性を向上させ、またガラス転移点を高くする効果があり、必須である。0. 5 %未満では前記効果が小さい。好ましくは2 %以上である。1 0. 5 %超では液相温度が高くなりすぎる、またはガラスが傷つきやすくなる。好ましくは5 %以下である。

【0 0 2 1】 Li_2O は必須ではないが、ガラスの溶解性を向上させるために3 %まで含有してもよい。3 %超ではガラスの耐候性が著しく低下する、ガラス転移点が低くなりすぎる、またはA Z S系電鍍煉瓦に対する侵食性が大きくなる。好ましくは2 %以下である。耐候性をより向上させたい場合、ガラス転移点をより高くしたい場合、またはA Z S系電鍍煉瓦に対する侵食性をより抑制したい場合は、 Li_2O を実質的に含有しないことが好ましい。

【0 0 2 2】 Na_2O は必須ではないが、ガラスの溶解性を向上させるために9 %まで含有してもよい。9 %超ではガラスの耐候性が著しく低下する、ガラス転移点が低くなりすぎる、またはA Z S系電鍍煉瓦に対する侵食性が大きくなる。好ましくは7 %以下である。

【0 0 2 3】 K_2O はガラスの溶解性を向上させる効果があり必須である。4 %未満では前記効果が小さい。好ましくは7 %以上である。2 1 %超ではガラスの耐候性が著しく低下する、ガラス転移点が低くなりすぎる、またはA Z S系電鍍煉瓦に対する侵食性が大きくなりすぎる。好ましくは1 6 %以下である。

【0 0 2 4】 Li_2O 、 Na_2O および K_2O の合計が1 0 %未満ではガラスの溶解性が低下する。好ましくは1

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2%以上である。2.2%超ではガラスの耐候性が著しく低下する、ガラス転移点が低くなりすぎる、またはAZS系電鍍煉瓦に対する侵食性が大きくなりすぎる。好ましくは1.7%以下、より好ましくは1.6%以下である。

【0025】本発明のガラスは実質的に上記成分からなるが、その他の成分を本発明の目的を損なわない範囲で含有してもよい。前記その他の成分の含有量の合計は10%以下であることが好ましい。より好ましくは5%以下である。前記その他の成分としては次のようなものが例示される。 SO_2 、 Cl 、 As_2O_3 、 Sb_2O_3 等の清澄剤を合計で1%まで含有してもよい。 TiO_2 と同様の効果を得るために SnO_2 を2%まで含有してもよい。ガラスの溶解性や安定性を向上させるために、 P_2O_5 、 V_2O_5 等を合計で3%まで含有してもよい。

【0026】本発明のガラスは、ピッカース硬さ H_v を破壊靱性 K_I で除して得られる脆さ指標値 $B (=H_v/K_I)$ が $7400\text{m}^{-1/2}$ 以下であることが好ましい。より好ましくは $7300\text{m}^{-1/2}$ 以下である。

【0027】本発明のガラスのガラス転移点は 600°C 以上であることが好ましい。 600°C 未満では磁性層形成のための熱処理温度を高くできず、磁性層の保磁力を増加させることが困難になるおそれがある。より好ましくは 620°C 以上である。

【0028】本発明のガラスは、その液相温度を T_L (単位: $^\circ\text{C}$)、その粘度が 10^4P (ポアズ)となる温度を T_v (単位: $^\circ\text{C}$)として、 $T_L - T_v < 50$ であることが好ましい。 $T_L - T_v \geq 50$ ではフロート成形が困難になるおそれがある。より好ましくは $T_L - T_v < 40$ 、特に好ましくは $T_L - T_v < 30$ である。

【0029】本発明のガラスは、磁気ディスク等の情報記録媒体に用いられるガラス基板またはPDP、FED等のフラットパネルディスプレイに用いられるガラス基板に好適である。

【0030】本発明の情報記録媒体用ガラス基板 (以下単に本発明のガラス基板という。) は本発明のガラスからなり、所定の寸法・形状に切断されたガラス板である。本発明のガラス基板は、 120°C 、2気圧の水蒸気雰囲気中に20時間保持したとき、該ガラス基板表面に存在する、大きさが $10\mu\text{m}$ 以上の付着物の数 N_L が $1\text{個}/\text{cm}^2$ 以下であり、大きさが $1\mu\text{m}$ 以上 $10\mu\text{m}$ 未満の付着物の数 N_S が $10^5\text{個}/\text{cm}^2$ 以下であることが好ましい。

【0031】 N_L が $1\text{個}/\text{cm}^2$ 超または N_S が $10^5\text{個}/\text{cm}^2$ 超では、ガラス基板在庫中にガラス基板表面に付着物 (白ヤケ) が発生し、ガラス基板上に形成される下地膜、磁性膜、保護膜等の膜がはがれやすくなるおそれがある。この付着物は、空気中の水分や炭酸ガスの影響によりガラス基板に生成付着した反応生成物であると考えられ、拭いても除去できないものである。 N_L はより好ましくは $0.5\text{個}/\text{cm}^2$ 以下、特に好ましくは0.

$2\text{個}/\text{cm}^2$ 以下である。 N_S はより好ましくは $0.8 \times 10^5\text{個}/\text{cm}^2$ 以下、特に好ましくは $0.6 \times 10^5\text{個}/\text{cm}^2$ 以下である。

【0032】本発明のガラスおよびガラス基板の製造方法は特に限定されず、各種方法を適用できる。たとえば、通常使用される各成分の原料を目標組成となるように調合し、これをガラス溶融窯で加熱溶融する。バブリング、攪拌、清澄剤の添加等によりガラスを均質化し、周知のフロート法、プレス法、フュージョン法、またダウンドロー法などの方法により所定の厚さのガラス板に成形し、徐冷後必要に応じて研削、研磨などの加工を行った後、所定の寸法・形状のガラス基板とされる。成形法としては、特に、大量生産に適したフロート法が好適である。本発明のガラス基板は、磁気ディスク用ガラス基板に好適である。

【0033】

【実施例】各成分の原料を表の SiO_2 から K_2O までの欄に質量百分率表示で示した組成となるように調合し、白金ろつばを用いて $1450 \sim 1550^\circ\text{C}$ の温度で3~5時間溶解した。溶解にあたっては、白金スターラを溶融ガラス中に挿入し、2時間攪拌してガラスを均質化した。次いで溶融ガラスを流し出して板状に成形し、徐冷した。なお、表の $\text{Si}-\text{Al}$ は SiO_2 の含有量から Al_2O_3 の含有量を減じた値を、 MgCaSrBa は MgO 、 CaO 、 SrO および BaO の含有量の合計を、 LiNaK は、 Li_2O 、 Na_2O および K_2O の含有量の合計を、それぞれ示す。

【0034】こうして得られたガラス板について、比重 d 、脆さ指標値 B (単位: $\text{m}^{-1/2}$)、ガラス転移点 T_g (単位: $^\circ\text{C}$)、液相温度 T_L (単位: $^\circ\text{C}$)、粘度が 10^4P となる温度 T_v (単位: $^\circ\text{C}$)、前記 N_L (単位: $\text{個}/\text{cm}^2$) および前記 N_S (単位: $10^5\text{個}/\text{cm}^2$) を、以下に示す方法により測定した。結果を表に示す。なお、測定を行わなかったものは表中に「-」で示す。

【0035】 d : 泡を含まない約 20g のガラス塊を用いてアルキメデス法によって測定した。

B : H_v および K_I を測定して B を求める方法ではなく、特開平10-152388号公報6欄27~40行に記載されている方法によって B を求めた。すなわち、ピッカース圧子を押し込んだときにガラス表面に残る圧子の痕の大きさ (単位: μm) と痕の四隅から発生するクラックの長さ (単位: μm) との関係式 $c/a = 0.0056B^{2/3}P^{1/6}$ から B を求めた。ここで、 P はピッカース圧子の押し込み力 (単位: N)、 a はピッカース圧痕の対角長、 c はピッカース圧痕の四隅から発生するクラックの長さ (圧子の痕を含む対称な2つのクラックの全長) である。

【0036】 T_g : 示差熱膨張計を用いて、石英ガラスを参照試料として室温から $5^\circ\text{C}/\text{分}$ の割合で昇温した際のガラスの伸び率を、ガラスが軟化してもはや伸びが観

測されなくなる温度、すなわち屈伏点まで測定し、得られた熱膨張曲線における屈曲点に相当する温度をガラス転移点とした。

T_i : ガラスを乳鉢で 2 mm 程度のガラス粒に粉碎し、このガラス粒を白金ボートに並べて置き、温度傾斜炉中で 24 時間熱処理した。結晶が析出しているガラス粒の温度の最高値を液相温度とした。

【0037】 T_i : 回転粘度計により測定した。

N_L、N_s : 厚さが 1 ~ 2 mm、大きさが 4 cm × 4 cm のガラス板の両面を鏡面研磨し、炭酸カルシウムおよび中性洗剤を用いて洗浄した後、超加速寿命試験器（不飽

和型プレッシャークッカー TPC-410、タバイエスベック社製）に入れて 120℃、2 気圧の水蒸気雰囲気中に 20 時間静置した。取り出したガラス板の表面 200 μm 角の範囲を微分干渉顕微鏡で観察し、大きさが 10 μm 以上の付着物の個数と大きさが 1 μm 以上 10 μm 未満の付着物の個数をカウントした。

【0038】 例 1 ~ 23 のガラスは実施例、例 24 のガラスは前記従来ガラスであり比較例である。

【0039】

【表 1】

	例 1	例 2	例 3	例 4	例 5	例 6	例 7	例 8	例 9	例 10
SiO ₂	59.9	63.0	62.2	68.8	61.0	64.0	68.4	62.7	63.0	60.5
Al ₂ O ₃	8.0	3.8	9.6	2.5	9.2	11.2	2.8	7.9	7.3	7.1
B ₂ O ₃	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MgO	3.2	4.3	4.6	5.8	2.4	3.8	4.5	0.6	8.7	4.5
CaO	6.7	9.2	6.4	9.0	3.4	5.3	6.3	10.4	0.9	6.3
SrO	3.7	0.0	2.8	0.4	3.1	0.0	0.0	1.6	3.3	1.6
BaO	0.0	0.0	0.0	1.3	0.0	2.4	3.1	0.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	3.0	3.4	1.7	1.3	4.4	1.0	2.1	2.9	2.1	4.1
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	2.3	1.0	5.3	4.3	6.6	8.2	4.9	5.5	6.7	2.9
K ₂ O	13.2	15.3	7.4	6.6	9.9	4.1	7.9	8.4	9.0	13.0
Si-Al	51.9	59.2	52.6	66.3	51.8	52.8	65.6	54.8	55.7	53.4
MgCaSrBa	13.6	13.5	13.8	16.5	8.9	11.5	13.9	12.6	12.9	12.4
LiNaK	15.5	16.3	12.7	10.9	16.5	12.3	12.8	13.9	14.7	15.9
d	2.58	2.55	2.55	2.53	2.57	2.53	2.53	2.56	2.53	2.58
B	7400	7200	7200	7200	7300	7200	7200	7200	7300	7400
T _g	669	682	648	634	667	652	646	657	642	682
T _L	1120	—	—	—	—	—	1120	—	—	1100
T _s	1171	—	—	1120	—	—	1156	—	—	1165
N _L	—	—	—	—	—	—	—	—	—	—
N _s	—	—	—	—	—	—	—	—	—	—

【0040】

【表 2】

	例 11	例 12	例 13	例 14	例 15	例 16	例 17	例 18	例 19	例 20
SiO ₂	61.7	71.3	64.6	60.6	59.3	65.2	64.8	63.4	63.6	63.7
Al ₂ O ₃	9.4	1.3	2.4	3.5	3.5	4.0	4.0	3.9	4.0	1.8
B ₂ O ₃	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
MgO	3.6	4.4	3.7	4.5	4.5	4.4	4.4	4.0	3.5	3.8
CaO	4.9	9.3	6.0	3.4	3.4	7.0	7.0	4.5	4.5	4.5
SrO	1.6	0.0	0.0	1.0	1.0	0.0	0.0	5.5	6.0	0.0
BaO	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0
TiO ₂	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZrO ₂	2.9	0.7	4.7	6.5	6.5	3.4	3.4	0.7	2.0	10.2
Li ₂ O	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Na ₂ O	6.7	8.3	0.5	0.0	0.0	2.0	1.0	0.0	0.5	0.0
K ₂ O	9.0	4.7	18.1	20.5	20.5	14.0	15.4	14.0	15.9	16.0
Si-Al	52.3	70.0	62.2	57.1	55.8	61.2	60.8	59.5	59.6	61.9
MgCaSrBa	11.3	13.7	9.7	8.9	8.9	11.4	11.4	18.0	14.0	8.3
LiNaK	14.7	13.0	18.6	20.5	20.5	18.0	16.4	14.0	16.4	16.0
d	2.55	2.47	2.52	2.55	2.55	2.52	2.51	2.59	2.55	2.58
B	7300	7100	7200	7300	7300	7200	7100	7300	7300	7350
T _s	665	612	672	672	672	657	663	631	642	672
T _L	—	—	1130	—	—	1140	1130	—	—	—
T ₄	—	—	1205	1214	1170	1192	1205	—	—	—
N _L	—	—	—	—	—	—	—	—	—	—
N _s	—	—	—	—	—	—	—	—	—	—

【 0 0 4 1 】

【 表 3 】

	例 21	例 22	例 23	例 24
SiO ₂	59.8	60.9	60.9	63.0
Al ₂ O ₃	9.6	9.5	9.5	14.0
B ₂ O ₃	0.0	0.0	0.0	0.0
MgO	5.0	5.0	5.0	0.0
CaO	6.3	6.1	6.1	0.0
SrO	2.1	1.6	1.6	0.0
BaO	0.0	0.0	0.0	0.0
TiO ₂	0.0	1.0	0.0	0.0
ZrO ₂	3.2	1.5	2.5	7.0
Li ₂ O	0.0	1.0	0.0	6.0
Na ₂ O	4.8	3.9	4.9	10.0
K ₂ O	9.2	9.5	9.5	0.0
Si-Al	50.2	51.4	51.4	49.0
MgCaSrBa	13.4	12.7	12.7	0.0
LiNaK	14.0	14.4	14.4	16.0
d	2.58	2.57	2.55	2.52
B	7300	7300	7300	—
T _s	662	630	645	500
T _L	1160	—	1190	—
T ₄	1170	—	1175	—
N _L	0	0	0	2×10 ⁴
N _s	0.3	0.4	0.3	4.0

【0042】

【発明の効果】本発明によれば、耐候性に優れ、割れにくく、ガラス転移点が高く、かつ大量生産に適したガラス基板、特に磁気ディスク等の情報記録媒体に用いられ

るガラス基板、PDP、FED等のフラットディスプレイに用いられるガラス基板を、化学強化処理を行うことなく提供できる。

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DD01 DE01 DF01 EA01 EA02
EA03 EB01 EB02 EB03 EC03
EC04 ED02 ED03 EE02 EE03
EE04 EF01 EF02 EF03 EG01
EG02 EG03 FA01 FB01 FB02
FB03 FC02 FC03 FC04 FD01
FE01 FF01 FG01 FH01 FJ01
FK01 FL01 GA01 GA10 GB01
GC01 GD01 GE01 HH01 HH03
HH05 HH07 HH09 HH11 HH13
HH15 HH17 HH20 JJ01 JJ03
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NN33 NN34
5C094 AA36 AA46 BA31 EB02 GB10
5D006 CB04 CB07

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